



ORIGINAL ARTICLE

Patterns of weight control behavior persisting beyond young adulthood: Results from a 15-year longitudinal study

Ann F. Haynos PhD¹  | Melanie M. Wall PhD² | Chen Chen MPH² | Shirley B. Wang BA³  |
Katie Loth PhD, MPH, RD⁴ | Dianne Neumark-Sztainer PhD, MPH, RD⁵

¹Department of Psychiatry, University of Minnesota, Minneapolis, Minnesota

²Department of Biostatistics, Columbia University, New York, New York

³Department of Psychology, Harvard University, Cambridge, Massachusetts

⁴Department of Family Medicine and Community Health, University of Minnesota, Minneapolis, Minnesota

⁵Division of Epidemiology and Community Health, School of Public Health, University of Minnesota, Minneapolis, Minnesota

Correspondence

Ann F. Haynos, PhD, Department of Psychiatry, University of Minnesota, 2450 Riverside Avenue, F253, Minneapolis, MN 55454.

Email: afhaynos@umn.edu

Funding information

National Institute of Mental Health, Grant/Award Numbers: K23MH112867, T32MH082761; National Heart, Lung, and Blood Institute, Grant/Award Number: R01HL093247

Abstract

Objective: Dieting and unhealthy weight control behaviors have been associated with negative outcomes. Most research has examined the prevalence of these behaviors in adolescence and young adulthood. Less is known about whether they persist further into adulthood. We examined patterns of weight control behaviors beyond young adulthood using data from 1,455 males and females participating in Project EAT (Eating and Activity in Teens and Young Adults), a 15-year population-based, longitudinal study.

Method: Participants completed surveys assessing dieting, high-frequency dieting (i.e., 5+ times/year), unhealthy weight control (e.g., fasting), and extreme weight control (e.g., vomiting) at each 5-year assessment (Waves 1–4). Longitudinal logistic regression models tested trends in weight control behaviors across the waves. Likelihood of persisting or discontinuing each behavior from Wave 3 to Wave 4 was examined through cross tabulations.

Results: Between Waves 3 and 4 in adulthood, dieting increased for both genders (Women: $p < .001$; Men: $p = .004$) and high-frequency dieting ($p < .001$) and unhealthy weight control behaviors ($p = .011$) increased for men. For both genders, dieting and unhealthy weight control patterns initiated in prior to young adulthood were more likely to persist than cease in adulthood ($ps < .001$).

Discussion: Weight control behaviors continue to be prevalent in adulthood, and to especially increase among men. Research is needed to understand the consequences of weight control behaviors in different life stages; however, the results suggest that interventions to decrease unhealthy weight management practices may be needed well into adulthood.

KEYWORDS

dieting, disordered eating, eating disorder, longitudinal, restrictive eating, unhealthy weight control

1 | INTRODUCTION

Attempts at weight control are common across the lifespan. Estimates suggest that one-third of adolescents (Neumark-Sztainer & Hannan, 2000) and two-thirds of adults (Reba-Harrelson et al., 2009) engage in dieting. A smaller, but still substantial portion of adolescents and adults engage in the most unhealthy and disordered forms of weight control, such as severely restricting intake, fasting, or purging through vomiting or laxatives (Bould, De Stavola, Lewis, & Micali, 2018; Mitchison, Hay, Slewa-Younan, & Mond, 2012). Although certain forms of weight management may be benign or, in some cases, recommended

(Haynos, Field, Wilfley, & Tanofsky-Kraff, 2015), even relatively common patterns of weight control behavior have been associated with negative psychological consequences. Dieting can increase the risk of eating disorders (Hilbert et al., 2014), and other psychological concerns, such as depressive symptoms and substance use (Krahn et al., 1996; Stice & Bearman, 2001). The most unhealthy and extreme weight control behaviors have also been associated with a host of negative physical and psychological consequences (Daee et al., 2002; Mitchison et al., 2012; Nagata et al., 2018; Solmi et al. 2015), including elevated risk of suicide attempt (Zuromski & Witte, 2015).

For this reason, it is necessary to determine how the patterns of these behaviors change across and between individuals at different time points in order to allocate prevention and intervention resources to periods when certain individuals may be at elevated risk due to engagement in weight control behaviors. Toward this end, Project EAT (Eating and Activity in Teens and Young Adults), a longitudinal study spanning adolescence (Wave 1; $M = 14.8$, $SD = 1.6$ years), emerging young adulthood (Wave 2; $M = 19.3$, $SD = 1.6$ years), young adulthood (Wave 3; $M = 25.2$, $SD = 1.7$ years), and adulthood (Wave 4; $M = 31.0$, $SD = 1.8$ years), has provided unique insights regarding the naturalistic time course of weight control behaviors over the life-span. The 10-year Project EAT results (Waves 1 through 3) demonstrated that dieting remained relatively stable for female participants over this period; however, for male participants, dieting decreased during emerging young adulthood, but again increased 5 years later in young adulthood (Neumark-Sztainer, Wall, Larson, Eisenberg, & Loth, 2011). On the other hand, rates of extreme forms of weight control behavior remained stable for male participants, but decreased in young adulthood among women (Neumark-Sztainer et al., 2011). These patterns have been supported by other research (Allen, Crosby, Oddy, & Byrne, 2013); however, there is some conflicting evidence suggesting that dieting and extreme weight control behaviors may increase for both males and females between adolescence and young adulthood (Liechty & Lee, 2013; Slof-Op 't Landt et al., 2017). These initial findings suggest that both adolescence and young adulthood may represent periods in which females are likely to engage in weight control behaviors, whereas males may be more drawn to weight control beginning in young adulthood compared with adolescence.

Because adolescence and emerging adulthood have been identified as peak periods for eating disorder onset (Stice, Marti, & Rhode, 2013), most prospective studies have examined weight control behaviors that may place individuals at risk of developing an eating disorder exclusively through these stages. However, progression further into adulthood is associated with increasing personal and professional responsibilities (Arnett, 2000), and simultaneous increases in body weight (Goldschmidt et al., 2018). These changes could impact the desire to engage in weight control behavior. Some preliminary evidence from prospective studies indicates that weight control behaviors may decrease for women in adulthood (Keel, Baxter, Heatherton, & Joiner, 2007; Rizvi, Stice, & Agras, 1999). However, other cross-sectional and longitudinal evidence suggests that dieting remains remarkably prevalent, and may increase, for women into adulthood (De Ridder, Adriaanse, Evers, & Verhoeven, 2014; Reba-Harrelson et al., 2009; Slof-Op 't Landt et al., 2017). For men, rates of dieting may remain stable or actually increase throughout adulthood (Keel et al., 2007; Rizvi et al., 1999; Slof-Op 't Landt et al., 2017). To our knowledge, no research to date has followed the same sample from adolescence beyond young adulthood to determine how weight control behaviors track or change within individuals over a longer span of time. Further information about changes in weight control into adulthood is needed to determine how common these behaviors are during this life stage, whether they are problematic, and, ultimately, whether intervention efforts are needed during this understudied period.

Additionally, most research has examined composite time courses of weight control behaviors across samples. Although this approach provides valuable information regarding how overall prevalence

changes with time, it cannot identify whether these data reflect persistence of weight control behaviors within the same individuals, or more complex patterns of different individuals initiating and discontinuing these behaviors over time. Examining weight control patterns in composite may also result in missing important patterns of heterogeneity. For instance, although prior Project-EAT group-level analyses found that dieting decreased overall for male participants between Waves 1 and 2 (Neumark-Sztainer et al., 2011), during this same time period, approximately 25% of male participants continued or initiated dieting (Neumark-Sztainer, Wall, Story, & Standish, 2012) and this subset of males gained more weight by Wave 3. Other research has demonstrated that weight control patterns vary according to clinical and demographic characteristics, including body mass, sexual minority status, or school setting (Bould et al., 2018; Nagata et al., 2018; Watson et al., 2017). Thus, by averaging data, group-level time courses may fail to capture information about alternate patterns of weight control behavior that could have critical implications for outcome. Data are lacking on patterns of heterogeneity in weight control behavior between young adulthood and adulthood, which could inform research on individuals with different risk profiles over time.

To address these gaps, and extend Project EAT 10-year longitudinal findings (Neumark-Sztainer et al., 2011) into the under-studied developmental transition beyond young adulthood, we examined the patterns of dieting, high-frequency dieting, and unhealthy and extreme weight control behavior between young adulthood (Wave 3) and adulthood (Wave 4). After summarizing the group level changes in weight control behaviors assessed every 5 years in the 15-year period, portions of which have been previously reported (Neumark-Sztainer et al., 2011), we examined group-level changes that occurred specifically between Waves 3 and 4. Next, to characterize patterns of heterogeneity in weight control behavior during the transition into adulthood, we examined the degree to which endorsement of dieting, high-frequency dieting, and unhealthy and extreme weight control behaviors at Waves 3 predicted continued or discontinued engagement in these behaviors at Wave 4. The overarching goal was to characterize patterns of weight control behaviors beyond young adulthood, which could ultimately inform the timing of intervention approaches for individuals for whom these eating behaviors may lead to negative psychological outcomes.

2 | METHOD

2.1 | Study design and population

Data were drawn from four waves of Project EAT. The analytic sample included 858 female and 597 male participants who responded at four time points (Waves 1 through 4). At Wave 1, conducted between 1998 and 1999, the original assessment involving surveys and anthropometric measures was designed as a cross-sectional study of students enrolled at middle schools and senior high schools in the Minneapolis-St. Paul metropolitan area of Minnesota. Given growing research interests in the eating and weight-related health of young people, a decision was made to follow-up at 5-year intervals with participants from the original sample who had provided sufficient

information at Wave 1 to be re-contacted ($n = 3,672$ of 4,746 Wave 1 participants). Follow-up mailed/online assessments were conducted in 2003–2004 (Wave 2) and 2008–2009 (Wave 3) to examine changes in the eating patterns and weight status of the original participants as they progressed through adolescence and young adulthood. The Wave 4 follow-up assessment in 2015–2016 was similarly conducted online and by mail with the purpose of building further understanding of the progression of eating behaviors and weight through adulthood. Only participants who previously responded to either or both Waves 2 and 3 ($n = 1,902$) were invited to participate. Wave 4 surveys were completed by 1,455 of these re-contacted participants. Baseline demographic composition of the sample can be found in Table 1. The local Institutional Review Board approved all study protocols.

2.2 | Survey development

Project EAT surveys were developed based upon focus groups with adolescents (Neumark-Sztainer, Story, Perry, & Casey, 1999),

literature reviews, content reviews by multidisciplinary experts, and pilot testing. Reliability has been reported for Waves 1 through 3 (Neumark-Sztainer et al., 2011) and was determined in Wave 4 using a subgroup of 103 participants who completed this survey twice within 1–4 weeks.

2.3 | Measures

2.3.1 | Dieting and high-frequency dieting

Dieting was assessed with the question: “How often have you gone on a diet during the last year? By ‘diet’ we mean changing the way you eat so you can lose weight” (0 = Never, 1 = One to four times, 2 = Five to 10 times, 3 = More than 10 times, and 4 = I am always dieting). As with previous analyses (Neumark-Sztainer et al., 2011), participants were dichotomized as not dieting (responded “Never”) or dieting (all other responses). In addition, high-frequency dieters were categorized as individuals endorsing a response of 2 (Five to 10 times) or higher on this item (Eisenberg & Neumark-Sztainer, 2010). Test-retest $\kappa = .77$ (any dieting) and $.68$ (high-frequency dieting).

TABLE 1 Baseline demographic characteristics and weight control behaviors between Wave 1 participants and Wave 4 completers (unweighted and weighted)

Variables	Wave 1 participants ($n = 4,746$)		Wave 4 completers (unweighted) ($n = 1,455$)			Wave 4 completers (weighted) ($n = 1,455$)	
	n	Mean (SD) or %	n	Mean (SD) or %	p value	Mean (SD) or %	p value
Age	4,736	14.9 (1.7)	1,455	14.9 (1.6)	.217	14.8 (1.6)	.488
Gender					<.001		.380
Male	2,377	50.2%	597	41.00%		51.5%	
Female	2,357	49.8%	858	59.00%		48.5%	
Race/ethnicity					<.001		.875
White	2,264	47.7%	1,037	71.30%	<.001	46.9%	.603
Black	887	18.7%	110	7.60%	<.001	19.0%	.789
Hispanic	273	5.8%	44	3.00%	<.001	5.2%	.402
Asian	896	18.9%	192	13.20%	<.001	19.2%	.761
Native American	165	3.5%	28	1.90%	.003	3.5%	.969
Mixed race/ethnicity	261	5.5%	44	3.00%	<.001	6.2%	.338
Socioeconomic status	4,550	3 (1.3)	1,432	3.4 (1.2)	<.001	2.9 (1.3)	.553
Overweight status					.006		.826
Not overweight	3,398	73.9%	1,108	77.50%		74.2%	
Overweight	1,198	26.1%	321	22.50%		25.8%	
Dieting					.379		.609
No	2,773	59.5%	843	58.20%		60.3%	
Yes	1,886	40.5%	605	41.80%		39.7%	
High-frequency dieting					.081		.049
No	4,050	86.9%	1,284	88.70%		88.9%	
Yes	609	13.1%	164	11.30%		11.1%	
Unhealthy weight control					.015		.598
No	2,544	54.8%	846	58.50%		55.6%	
Yes	2,095	45.2%	601	41.50%		44.4%	
Extreme weight control					.162		.139
No	4,251	91.5%	1,341	92.70%		92.7%	
Yes	394	8.5%	106	7.30%		7.3%	

Note. Baseline differences between Wave 1 sample and Wave 4 completers (unweighted and weighted) are assessed using t-tests for continuous measures and chi-square test for categorical measures. Weighted estimates are adjusted using inverse probability weighting. Socioeconomic status range: 0 (lowest) to 5 (highest). High-frequency dieting = 5+ times/year.

2.3.2 | Unhealthy and extreme weight control behavior

Weight control behaviors were assessed with the question stem: "Have you done any of the following things in order to lose weight or to keep from gaining weight during the past year?" (0 = No, 1 = Yes to each behavior). As with prior analyses (Neumark-Sztainer et al., 2011), the following behaviors were categorized as *unhealthy weight control behaviors*: (1) fasted; (2) ate very little food; (3) used a food substitute (powder or a special drink); (4) skipped meals; (5) smoked more cigarettes; (6) took diet pills; (7) made myself vomit; (8) used laxatives; and (9) used diuretics. Participants were dichotomized as not using unhealthy weight control behaviors (reported none of these behaviors) or using unhealthy weight control behaviors (reported one or more behaviors). Test-retest $\kappa = .72$. Consistent with prior research (Neumark-Sztainer et al., 2011), the unhealthy weight control behaviors considered most problematic were categorized as *extreme weight control behaviors*, including: (1) took diet pills; (2) made myself vomit; (3) used laxatives; and (4) used diuretics. Participants were dichotomized as not using extreme weight control behavior (reported no extreme weight control behavior) or using extreme weight control behavior (reported one or more behavior). Test-retest $\kappa = .84$.

2.3.3 | Demographics

Participants self-reported age, gender, race/ethnicity, and socioeconomic status at Wave 1. Participants also self-reported height and weight at each assessment point, which were used to determine body mass index (BMI). Overweight status was determined using a BMI cut-off of ≥ 85 th percentile for age and gender (Kuczmarski et al., 2000) at Waves 1 and 2, when participants were primarily adolescents or emerging young adults, and a BMI cutoff of ≥ 25 kg/m² at Waves 3 and 4, when all participants were adults. Correlations between reported and measured BMI demonstrated high correspondence (Himes, Hannan, Wall, & Neumark-Sztainer, 2005).

2.4 | Data analytic plan

Non-completion did not occur completely at random and thus to account for missing data, inverse probability weighting was used for all analyses (Little, 1982). Inverse probability weighting is the recommended method for handling missing data in longitudinal studies in which individuals who do not respond to surveys at various assessment time points have missing values on many variables (Seaman & White, 2013). This method minimizes the potential for response bias due to missing data and allows for extrapolation back to the original sample. Inverse probability weights were derived based on key Wave 1 covariates, including demographics, overweight status, parental living situation, and grades in school, so that the subjects who responded to all four time points represented the EAT Wave 1 population. Prior to weighting, it was determined that non-completers were more likely to be male, non-white, and overweight, and less likely to report unhealthy weight control behaviors at Wave 1 (see Table 1). After weighting, there were no significant differences between the analytic sample and the original Wave 1 sample on any of these variables ($ps > .14$), with the exception of high-frequency dieting, which was marginally higher in the analytic sample compared with the

original sample ($p = .049$). All analyses described below incorporated the non-response weighting.

First, we summarized and extended the 10-year longitudinal findings shown in previous analyses (Neumark-Sztainer et al., 2011) by examining 15-year longitudinal trends in dieting and unhealthy and extreme weight control behaviors using longitudinal logistic regression with correlation across repeated measures incorporated using generalized estimating equations. To remain consistent with our prior analysis (Neumark-Sztainer et al., 2011), we adjusted for Wave 1 age, SES, and race/ethnicity, and stratified by gender. These covariates were selected based on their potential to unduly influence estimates of weight control behaviors (Field et al., 2003; Rogers, Resnick, Mitchell, & Blum, 1997). To address the first research question, which characterized which of these changes specifically occurred in adulthood, follow-up contrasts from the longitudinal logistic regression quantified change in dieting and unhealthy and extreme weight control behaviors specifically between Waves 3 and 4. Because we wished to determine the degree to which these changes were influenced by weight changes occurring over the same period (Goldschmidt et al., 2018), these analyses were repeated statistically adjusting for overweight status. To examine the second research question, which investigated heterogeneity in patterns of weight control between Waves 3 and 4, cross tabulations of whether a subject had an outcome at Waves 3 with Wave 4 outcome were created. One-sample proportion tests were used to test whether the majority of subjects who had an outcome at Wave 3 persisted into Wave 4. Analyses were performed in SAS 9.4.

3 | RESULTS

Paralleling the 10-year longitudinal results of this study (Neumark-Sztainer et al., 2011), prevalence of dieting increased for both male (22.9% to 43.8%, OR = 1.4, 95% confidence interval [CI]: 1.3–1.6, $p < .001$) and female (55.5% to 65.4%, OR = 1.1, 95% CI: 1.1–1.2, $p < .001$) participants over the 15-year period between adolescence and adulthood (see Figure 1). However, high-frequency dieting remained stable for males, and decreased for females (15.7% to 10.4%, OR = 0.8, 95% CI: 0.7–0.9, $p < .001$). Over this same period, use of unhealthy weight control behaviors increased for male participants (29.2% to 37.9%, OR = 1.1, 95% CI: 1.0–1.2, $p = .032$), but slightly decreased for female participants (56.4% to 53.5%, OR = 0.9, 95% CI: 0.9–1.0, $p = .040$), whereas use of extreme unhealthy weight control behaviors increased for both male (2.4% to 8.6%, OR = 1.3, 95% CI: 1.1–1.6, $p = .003$) and female (11.3% to 18.5%, OR = 1.2, 95% CI: 1.1–1.3, $p = .003$) participants.

3.1 | Weight control prevalence changes in adulthood

When examining which of these changes occurred specifically in adulthood, results indicated that dieting increased for both men (35.2% to 43.8%, OR = 1.4, 95% CI: 1.1–1.8, $p = .004$) and women (56.5% to 65.4%, OR = 1.5, 95% CI: 1.2–1.7, $p < .001$) from Wave 3 to Wave 4. For men, increases were also noted in high-frequency dieting (3.2% to 8.6%, OR = 2.9, 95% CI: 1.6–5.3, $p < .001$) and unhealthy weight control

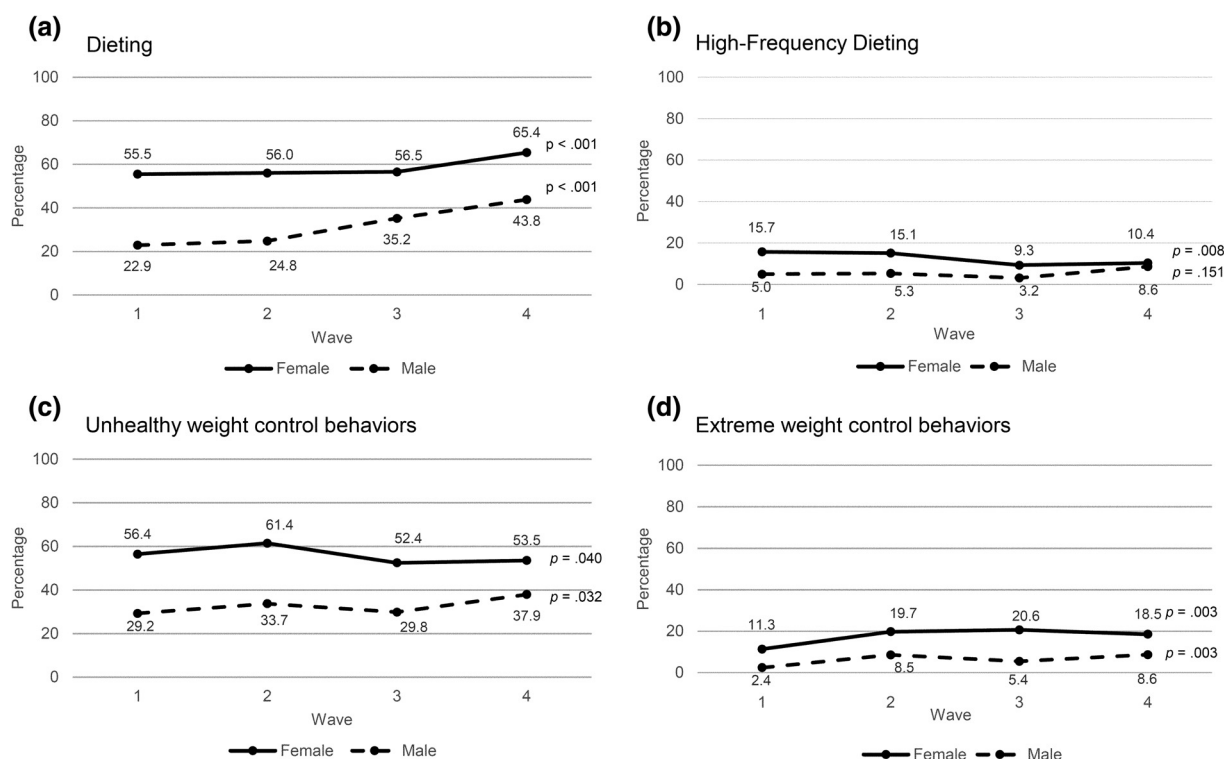


FIGURE 1 Prevalence of (a) dieting, (b) high-frequency dieting, (c) unhealthy weight control behaviors, and (d) extreme weight control behaviors from adolescence to adulthood by gender

behaviors (29.8% to 37.9%, $OR = 1.4$, 95% CI: 1.1–1.9, $p = .01$). There were no significant changes in high-frequency dieting (9.3% to 10.4%, $OR = 1.1$, 95% CI: 0.8–1.5, $p = .43$) or unhealthy weight control behaviors (52.4% to 53.5%, $OR = 1.0$, 95% CI: 0.9–1.3, $p = .65$) for women or extreme weight control for men (5.4% to 8.6%, $OR = 1.7$, 95% CI: 0.9–2.9, $p = .08$) or women (20.6% to 18.5%, $OR = 0.9$, 95% CI: 0.7–1.2, $p = .36$) between these waves, suggesting that any previously noted changes in these behaviors did not occur in adulthood. Only the increases in dieting for women ($OR = 1.4$, 95% CI: 1.1–1.7, $p = .010$) and in high-frequency dieting for men ($OR = 2.7$, 95% CI: 1.5–5.1, $p = .002$) remained statistically significant after adjusting for overweight status.

3.2 | Weight control stability and change in adulthood

For all weight control behaviors, status in young adulthood (Wave 3) significantly predicted status in adulthood (Wave 4; $ps < .001$, see Table 2), suggesting that, on average, those who engaged in weight control behaviors in young adulthood were more likely to persist in these behaviors into adulthood, and those who had not engaged in these behaviors in young adulthood were less likely to initiate these behaviors in adulthood. However, there were several distinct patterns of stability and change in weight control use between the two time points.

For both men and women, dieting in young adulthood predicted dieting in adulthood at a rate greater than chance ($ps < .001$). For men, the most common pattern was to not endorse dieting at either Wave 3 or 4 (48.1%), with fewer individuals endorsing dieting at both waves (24.2%); whereas, for women, the most common pattern was to endorse dieting at both waves (45.9%), with fewer individuals denying dieting at both waves (25.9%). However, notable subsets of

men (18.8%) and women (17.4%) were identified who initiated dieting in adulthood. Engaging in high-frequency dieting in young adulthood did not significantly predict high-frequency dieting in adulthood for men ($p = .87$) or women ($p = .84$), suggesting that this level of dieting generally did not persist over time. The most common pattern for both men (90.9%) and women (84.4%) was to not engage in high-frequency dieting at either time point.

For both men and women, engaging in unhealthy weight control behaviors in young adulthood predicted engaging in these behaviors in adulthood at a rate greater than chance ($ps < .001$). For men, the most common pattern was to not endorse unhealthy weight control behavior at either time point (54.2%), with prominent subsets endorsing unhealthy weight control at both time points (18.5%) or initiating unhealthy weight control behavior in adulthood (16.6%). Most women either endorsed unhealthy weight control at both (35.4%) or neither (35.1%) Wave 3 and 4, with some ceasing use of unhealthy weight control behavior in adulthood (16.5%). Endorsing extreme weight control behavior in young adulthood did not significantly predict extreme weight control behavior in adulthood for men ($p = .99$) or women ($p = .77$), suggesting that most individuals who engaged in extreme weight control behaviors in young adulthood had stopped using these behaviors. The most common pattern for both men (88.6%) and women (73.4%) was to not engage in extreme weight control behavior in either young adulthood or adulthood.

4 | DISCUSSION

This study examined patterns in the use of dieting, high-frequency dieting, unhealthy weight control behaviors, and extreme weight

TABLE 2 Patterns of stability and change of weight control behaviors between Wave 3 (young adulthood) and Wave 4 (adulthood)

		Male			Female		
	Outcome at Wave 3		Outcome at W4	<i>p</i>		Outcome at W4	<i>p</i>
Dieting	Yes	197 (36.6%)	Yes 144 (24.2%)	<.001	489 (57.6%)	Yes 394 (45.9%)	<.001
			No 53 (8.9%)			No 95 (11.1%)	
	No	398 (63.4%)	Yes 112 (18.8%)		369 (42.4%)	Yes 149 (17.4%)	
			No 286 (48.1%)			No 220 (25.9%)	
High-frequency dieting	Yes	21 (3.5%)	Yes 6 (1.0%)	<.001	78 (10.4%)	Yes 26 (3.0%)	<.001
			No 15 (2.5%)			No 52 (6.0%)	
	No	574 (96.5%)	Yes 33 (5.5%)		780 (89.7%)	Yes 56 (6.5%)	
			No 541 (90.9%)			No 724 (84.4%)	
Unhealthy weight control behavior	Yes	174 (32.2%)	Yes 110 (18.5%)	<.001	443 (54.2%)	Yes 302 (35.4%)	<.001
			No 64 (10.7%)			No 141 (16.5%)	
	No	422 (67.8%)	Yes 99 (16.6%)		410 (45.8%)	Yes 111 (13.0%)	
			No 323 (54.2%)			No 299 (35.1%)	
Extreme weight control behavior	Yes	37 (5.9%)	Yes 9 (1.5%)	<.001	166 (22.1%)	Yes 75 (8.8%)	<.001
			No 28 (4.7%)			No 91 (10.7%)	
	No	559 (94.1%)	Yes 31 (5.2%)		687 (77.9%)	Yes 61 (7.2%)	
			No 528 (88.6%)			No 626 (73.4%)	

Note. Significance tests reflect results of cross-tabulations used to examine whether Wave 3 status predicted Wave 4 outcome. All percentages reflect proportion of total Wave 4 sample. High-frequency dieting = 5+ times/year.

control behaviors in a longitudinal sample as they developed beyond young adulthood. High rates of dieting and unhealthy weight control behaviors continued to be reported in adulthood. From young adulthood to adulthood, dieting increased for both genders and high-frequency dieting and unhealthy weight control behaviors increased among men. These results provide evidence that many weight control behaviors continue to be prominent as individuals' transition into adulthood and, therefore, there is a need for research on the consequences of different weight control behaviors during this developmental stage. Considered in the context of the negative physical and psychological effects of dieting and unhealthy weight control that have been reported (Daee et al., 2002; Mitchison et al., 2012; Nagata et al., 2018; Solmi et al., 2015), the findings of this study suggest that some individuals may continue to be at risk of negative outcomes resulting from weight control behaviors beyond adolescence and young adulthood. Because most intervention efforts for avoiding or reducing unhealthy weight control behaviors are geared toward adolescents (Le, Barendregt, Hay, & Mihalopoulos, 2017), there may be an unmet need for moderating these practices among at risk individuals in adulthood.

Additionally, this study examined patterns of stability and change in weight control behaviors. The results indicated that dieting and unhealthy weight control behaviors that had been initiated prior to young adulthood were more likely to be maintained than stopped in adulthood, corresponding with prior results from our group indicating the persistence of weight control behaviors over time (Neumark-Sztainer et al., 2012). These findings highlight the importance of delivering intervention early to those engaging in weight control behaviors that have a negative physical and psychological impact, since these patterns are unlikely to discontinue as an individual progresses throughout the lifespan. However, in line with other research (Bould et al., 2018; Nagata et al., 2018; Watson et al., 2017), we also noted

several patterns of heterogeneity, revealing complexity in the data not captured by population-level prevalence rates. Although persistence in use or non-use of weight control behaviors was the norm across behaviors, other patterns were also common. For instance, nearly one in five individuals reported initiating dieting in adulthood, and a similar percentage of women stopped using unhealthy weight control behaviors in adulthood. Individuals in these smaller, but not negligible, subsets of the sample could represent groups who are engaging with weight control behaviors in different ways, or who experience alternate consequences associated with these behaviors. Future research is encouraged to understand the association between different dieting patterns across the lifespan and various psychological and physical consequences.

Important gender differences were detected in patterns of weight control behaviors in adulthood, paralleling those reported in previous research (Allen et al., 2013; Keel et al., 2007; Rizvi et al., 1999). Women had higher rates of all weight control behaviors during adulthood, with nearly half endorsing dieting and over a third endorsing unhealthy weight control behavior consistently between young adulthood and adulthood. Men, on the other hand, although less severe in overall prevalence of weight control, escalated use of dieting, high-frequency dieting, and unhealthy weight control behaviors into adulthood. These gender differences have several implications. First, they highlight the commonality of weight control practices among females across time. Second, they suggest that dieting and unhealthy weight control behaviors may become more prevalent for males in adulthood and, therefore, the key stages for intervening on problematic weight control practices among this group may be later than for females. Further, the findings of the study highlight the importance of studying weight control trends among both males and females. Because lower rates of eating disorders have been reported among males compared with females (Sweeting et al., 2015), males have often been excluded

in longitudinal studies examining potentially problematic eating patterns (e.g., Lewinsohn, Striegel-Moore, Seeley, 2000; Vohs, Heatherton, & Herrin, 2001). However, this practice has led to limited knowledge on the patterns of weight control, and the implications of these behaviors, in this group. The different pattern of results between men and women in this study highlights the importance of including, and separately examining, males in longitudinal examinations of weight control behaviors.

Despite many of the results underscoring the persistence of weight control behavior into adulthood, a few potentially encouraging trends in the data were detected. Our prior research found that use of unhealthy weight control behaviors decreased for women prior to young adulthood (Neumark-Sztainer et al., 2011), and the analyses of this study suggested that this change remained stable into adulthood. In addition, high-frequency dieting and extreme unhealthy weight control behaviors initiated earlier in life were more likely to cease than continue in the transition into adulthood. Indeed, the prevalence of these types of weight-control behavior in adulthood was quite low. These findings suggest that many people are able to disengage from weight control practices, especially those that are the most severe, after they have commenced. Future research is needed to determine what differentiates those who cease unhealthy weight control practices from those engaging in persistent use.

One other notable finding from this analysis was that changes in weight control behaviors in adulthood appeared to be closely linked to increases in weight during this same period (Goldschmidt et al., 2018). For men, increases in dieting and unhealthy weight control behaviors in adulthood were no longer statistically significant after adjusting for overweight status. This could indicate that dieting behaviors among men in adulthood reflect less problematic attempts to maintain a healthy weight status. On the contrary, however, the findings could suggest that men increasingly turn toward potentially harmful practices when weight naturally increases with age. There is evidence that unhealthy weight control use in adulthood among those at higher weights can have negative effects upon health indices (Nagata et al., 2018). To more completely understand the implication of these effects, additional data are needed to characterize the association between gender, overweight status, and negative psychological outcomes. However, increases in dieting among women in adulthood, as well as increases in high-frequency dieting in men remained after adjusting for weight status, suggesting that not all weight control attempts solely reflect a response to naturally occurring weight increases.

This study has important strengths. The extended length of the longitudinal assessment allowed for an examination of weight control behaviors throughout a range of critical developmental periods, including the under-researched transition beyond young adulthood. Additionally, the large population-based sample permitted for generalization of the findings beyond studies examining changes in eating behaviors over time that have exclusively or primarily focused on female, White, or higher SES individuals (e.g., Lewinsohn et al., 2000; Keel et al., 2007; Vohs et al., 2001). Study limitations also warrant consideration. Dieting and unhealthy weight control are complex constructs (Haynos et al., 2015), and it is likely that at least some individuals endorsing these behaviors were engaging in less problematic

forms of weight management. More research is needed to understand the impact of these behaviors in adulthood, especially in the understudied group of men. All variables, including height and weight, were self-reported and assessment of weight control behaviors required recall over the previous year. These aspects of the study measurement potentially subject participants to inaccurate reporting. Weight control behaviors were also assessed using brief, dichotomized measures; therefore, we could not characterize how the frequency and severity of these behaviors changed. Additionally, prevalence of weight control behaviors in the United States has changed over time (Watson et al., 2017); therefore, some findings may reflect time trends, rather than those specific to developmental stage. Future research in this area would benefit from a wider range of measures, including objective assessments of weight and eating habits. Finally, as anticipated in a longitudinal study, attrition occurred. Those for whom full data were available were more likely to be female, White, and to endorse unhealthy weight control behaviors and to not report being overweight at baseline, which may have resulted in biased estimates. The sample was weighted to reflect the original study population (Little, 1982) in order to potentially reduce the potential for bias; however, there remained a slight bias toward a sample endorsing more high-frequency dieting at baseline. Thus, the results of this study warrant replication.

The results of this study extend prior findings (Neumark-Sztainer et al., 2011) to demonstrate that dieting and unhealthy and extreme weight control behaviors continue beyond young adulthood. In fact, prevalence of dieting, and unhealthy weight control behaviors for men, continues to climb during this period, and individuals who have initiated these weight control behaviors earlier in their life are likely to persist in them into adulthood. These trends are concerning given prior research indicating negative consequences from dieting and other weight-control behaviors (Daee et al., 2002; Mitchison et al., 2012; Nagata et al., 2018; Solmi et al., 2015), and the potential for intergenerational transmission of harmful eating- and weight-related practices as more individuals transition to parenthood during this life stage (Berge et al., 2018). More information is needed to understand the impact of various weight control practices during different developmental stages. However, the current findings highlight the potential need for intervention toward decreasing the use of possibly detrimental weight control practices in adulthood.

ACKNOWLEDGMENTS

Research reported in this publication was supported by the National Heart, Lung, and Blood Institute under award number R01HL093247 and the National Institute of Mental Health under award numbers T32MH082761 and K23MH112867.

ORCID

Ann F. Haynos  <https://orcid.org/0000-0002-2548-1731>

Shirley B. Wang  <https://orcid.org/0000-0002-8583-3014>

REFERENCES

- Allen, K. L., Crosby, R. D., Oddy, W. H., & Byrne, S. M. (2013). Eating disorder symptom trajectories in adolescence: Effects of time, participant sex, and early adolescent depressive symptoms. *Journal of Eating Disorders*, 1, 32.
- Arnett, J. J. (2000). Emerging adulthood: A theory of development from the late teens through the twenties. *American Psychologist*, 55, 469–480.
- Berge, J. M., Winkler, M. R., Larson, N., Miller, J., Haynos, A. F., & Neumark-Sztainer, D. (2018). Intergenerational transmission of parent encouragement to diet from adolescence into adulthood. *Pediatrics*, 41, e20172955. <https://doi.org/10.1542/peds.2017-2955>
- Bould, H., De Stavola, B., Lewis, G., & Micali, N. (2018). Do disordered eating behaviours in girls vary by school characteristics? A UK cohort study. *European Child and Adolescent Psychiatry*, 2018, 1–9.
- Daele, A., Robinson, P., Lawson, M., Turpin, J. A., Gregory, B., & Tobias, J. D. (2002). Psychologic and physiologic effects of dieting in adolescents. *Southern Medical Journal*, 95, 1032–1041.
- De Ridder, D., Adriaanse, M., Evers, C., & Verhoeven, A. (2014). Who diets? Most people and especially when they worry about food. *Appetite*, 80, 103–108.
- Eisenberg, M. E., & Neumark-Sztainer, D. (2010). Friends' dieting and disordered eating behaviors among adolescents five years later: Findings from project EAT. *Journal of Adolescent Health*, 47, 67–73.
- Field, A. E., Austin, S. B., Taylor, C. B., Malspeis, S., Rosner, B., Rockett, H. R., ... Colditz, G. A. (2003). Relation between dieting and weight change among preadolescents and adolescents. *Pediatrics*, 112, 900–906.
- Goldschmidt, A. B., Wall, M. M., Choo, T. J., Evans, E. W., Jelalian, E., Larson, N., & Neumark-Sztainer, D. (2018). Fifteen-year weight and disordered eating patterns among community-based adolescents. *American Journal of Preventive Medicine*, 54, e21–e29.
- Haynos, A. F., Field, A. E., Wilfley, D. E., & Tanofsky-Kraff, M. (2015). A novel classification paradigm for understanding the positive and negative outcomes associated with dieting. *International Journal of Eating Disorders*, 48, 362–366.
- Hilbert, A., Pike, K. M., Goldschmidt, A. B., Wilfley, D. E., Fairburn, C. G., Dohm, F. A., ... Striegel Weissman, R. (2014). Risk factors across the eating disorders. *Psychiatry Research*, 220, 500–506.
- Himes, J. H., Hannan, P., Wall, M., & Neumark-Sztainer, D. (2005). Factors associated with errors in self-reports of stature, weight, and body mass index in Minnesota adolescents. *Annals of Epidemiology*, 15, 272–278.
- Keel, P. K., Baxter, M. G., Heatherton, T. F., & Joiner, T. E., Jr. (2007). A 20-year longitudinal study of body weight, dieting, and eating disorder symptoms. *Journal of Abnormal Psychology*, 116, 422–432.
- Krahn, D., Piper, D., King, M., Olson, L., Kurth, C., & Moberg, D. P. (1996). Dieting in sixth grade predicts alcohol use in ninth grade. *Journal of Substance Abuse*, 8, 293–301.
- Kuczmarski, R. J., Ogden, C. L., Grummer-Strawn, L. M., Flegal, K. M., Guo, S. S., Wei, R., ... Johnson, C. L. (2000). CDC growth charts: United States. *Advance Data*, 314, 1–27.
- Le, L. K., Barendregt, J. J., Hay, P., & Mihalopoulos, C. (2017). Prevention of eating disorders: A systematic review and meta-analysis. *Clinical Psychology Review*, 53, 46–58.
- Lewinsohn, P. M., Striegel-Moore, R. H., & Seeley, J. R. (2000). Epidemiology and natural course of eating disorders in young women from adolescence to young adulthood. *Journal of the American Academy of Child and Adolescent Psychiatry*, 39, 1284–1292.
- Liechty, J. M., & Lee, M. J. (2013). Longitudinal predictors of dieting and disordered eating among young adults in the U.S. *International Journal of Eating Disorders*, 46, 790–800.
- Little, R. J. A. (1982). Models for non-response in sample surveys. *Journal of the American Statistical Association*, 77, 237–250.
- Mitchison, D., Hay, P., Sleva-Younan, S., & Mond, J. (2012). Time trends in population prevalence of eating disorder behaviors and their relationship to quality of life. *PLoS One*, 7, e48450.
- Nagata, J. M., Garber, A. K., Tabler, J., Murray, S. B., Vittinghoff, E., & Bibbins-Domingo, K. (2018). Disordered eating behaviors and cardiometabolic risk among young adults with overweight or obesity. *International Journal of Eating Disorders*. <https://doi.org/10.1002/eat.22927>
- Neumark-Sztainer, D., & Hannan, P. J. (2000). Weight-related behaviors among adolescent girls and boys: Results from a national survey. *Archives of Pediatrics & Adolescent Medicine*, 154, 569–577.
- Neumark-Sztainer, D., Story, M., Perry, C., & Casey, M. A. (1999). Factors influencing food choices of adolescents: Findings from focus-group discussions with adolescents. *Journal of the American Dietetic Association*, 99, 929–937.
- Neumark-Sztainer, D., Wall, M., Larson, N., Eisenberg, M. E., & Loth, K. (2011). Dieting and disordered eating behaviors from adolescence to young adulthood: Findings from a 10-year longitudinal study. *Journal of the American Dietetic Association*, 111, 1004–1011.
- Neumark-Sztainer, D., Wall, M., Story, M., & Standish, A. R. (2012). Dieting and unhealthy weight control behaviors during adolescence: Associations with 10-year changes in body mass index. *Journal of Adolescent Health*, 50, 80–86.
- Reba-Harrelson, L., Von Holle, A., Hamer, R. M., Swann, R., Reyes, M. L., & Bulik, C. M. (2009). Patterns and prevalence of disordered eating and weight control behaviors in women ages 25–45. *Eating and Weight Disorders*, 14, e190–e198.
- Rizvi, S. L., Stice, E., & Agras, W. S. (1999). Natural history of disordered eating attitudes and behaviors over a 6-year period. *International Journal of Eating Disorders*, 26, 406–413.
- Rogers, L., Resnick, M. D., Mitchell, J. E., & Blum, R. W. (1997). The relationship between socioeconomic status and eating-disordered behaviors in a community sample of adolescent girls. *International Journal of Eating Disorders*, 22, 15–23.
- Seaman, S. R., & White, I. R. (2013). Review of inverse probability weighting for dealing with missing data. *Statistical Methods in Medical Research*, 22, 278–295.
- Slof-Op 't Landt, M. C. T., van Furth, E. F., van Beijsterveldt, C. E. M., Bartels, M., Willemsen, G., de Geus, E. J., ... Boomsma, D. I. (2017). Prevalence of dieting and fear of weight gain across ages: A community sample from adolescents to the elderly. *International Journal of Public Health*, 62, 911–919.
- Solmi, F., Sonnevile, K. R., Easter, A., Horton, N. J., Crosby, R. D., Treasure, J., ... Micali, N. (2015). Prevalence of purging at age 16 and associations with negative outcomes among girls in three community-based cohorts. *Journal of Child Psychology and Psychiatry*, 56, 87–96.
- Stice, E., & Bearman, S. K. (2001). Body-image and eating disturbances prospectively predict increases in depressive symptoms in adolescent girls: A growth curve analysis. *Developmental Psychology*, 37, 597–607.
- Stice, E., Marti, C. N., & Rohde, P. (2013). Prevalence, incidence, impairment, and course of the proposed DSM-5 eating disorder diagnoses in an 8-year prospective community study of young women. *Journal of Abnormal Psychology*, 122, 445–157.
- Sweeting, H., Walker, L., MacLean, A., Patterson, C., Räisänen, U., & Hunt, K. (2015). Prevalence of eating disorders in males: A review of rates reported in academic research and UK mass media. *International Journal of Mens Health*, 14, 86.
- Vohs, K. D., Heatherton, T. F., & Herrin, M. (2001). Disordered eating and the transition to college: A prospective study. *International Journal of Eating Disorders*, 29, 280–288.
- Watson, R. J., Adjei, J., Saewyc, E., Homma, Y., & Goodenow, C. (2017). Trends and disparities in disordered eating among heterosexual and sexual minority adolescents. *International Journal of Eating Disorders*, 50, 22–31.
- Zuromski, K. L., & Witte, T. K. (2015). Fasting and acquired capability for suicide: A test of the interpersonal-psychological theory of suicide in an undergraduate sample. *Psychiatry Research*, 226, 61–67.

How to cite this article: Haynos AF, Wall MM, Chen C, Wang SB, Loth K, Neumark-Sztainer D. Patterns of weight control behavior persisting beyond young adulthood: Results from a 15-year longitudinal study. *Int J Eat Disord*. 2018;51: 1090–1097. <https://doi.org/10.1002/eat.22963>